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**April 2003**

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**SAMPLING AND ANALYSIS PLAN**

**Karwick Road Landfill Site  
Michigan City, Indiana**

***Prepared for:***

Michigan City Parks & Recreation Department  
100 E. Michigan Blvd.  
Michigan City, Indiana 46360

***Prepared by:***

APT, Limited  
6910 N. Main Street, Unit 17  
Granger, Indiana 46530

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**Project No. 312-01**

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## 1.0 INTRODUCTION

The purpose of this Sampling and Analysis Plan (SAP) is to establish sampling and analysis procedures associated with a site investigation at the former Karwick Road Landfill site in Michigan City, Indiana consistent with the *Indiana Department of Environmental Management (IDEM) – Voluntary Remediation Program (VRP) Resource Guide* (July 1996). The sampling and analysis procedures are required to evaluate the extent of potential soil and groundwater impacts at the former Karwick Road Landfill site. Additionally, investigative activities conducted within the potentially impacted areas may be used to determine remedial action alternatives, if necessary. This SAP lists the procedures to be followed so that any qualified individual adhering to the procedures outlined in the SAP can obtain soil, groundwater, surface water, and sediment samples at the identified locations and intervals presented in this SAP, and any subsequent investigatory activities at the facility.

This SAP includes discussion of equipment and materials, sampling procedures, chain-of-custody and field documentation procedures, target monitoring parameters, field measurement procedures, decontamination procedures, and quality assurance procedures. Information presented in the text of this SAP includes, but is not limited to, sampling procedures, analytical methods, sample containers, sample preservation, holding times, and chain-of-custody procedures, specific to the former Karwick Road Landfill site.



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## 2.0 FACILITY LOCATION AND BACKGROUND

The former Karwick Road Landfill site is located on Karwick Road near the intersection of Warnke Road in Michigan City, Indiana (Figure 1). The site consists of approximately 23.5 acres, contains no buildings or structures, and is largely overgrown with weeds and small trees. The property is bounded on the north and south by rail lines, on the east by Karwick Road, and on the west by a creek (Figure 2). The site has not been used for landfill purposes since the 1960s, and is currently a vacant unused property. In order to mitigate the potential environmental liability posed by the former landfill, the site was entered into the Indiana Voluntary Remediation Program (VRP) in early 2002 by the Michigan City Parks and Recreation Department (MCPRD). The site was accepted into the VRP in February 2002.

A Phase I Environmental Site Assessment (ESA) conducted at the site by APT, Limited (APT) in March 2002 identified two potential recognized environmental conditions (RECs) associated with the property. These are identified as follows:

- REC-1: Buried Waste – The entire site was used as a municipal landfill. There is no available history of the types of waste accepted at the landfill. Information received from Michigan City personnel indicate that the landfill was used primarily to dispose of household waste. However, partially buried drums observed at the time of the site walk-through indicate that all types of waste may have been received at the facility. Therefore, the buried waste represents an REC.
- REC-2: Site-Wide Groundwater Issues – Due to the dates of operations at the facility and lack of information regarding management practices, the possibility of buried chemicals and the resulting leachate which may have affected the groundwater quality at the facility cannot be mitigated. Therefore, site-wide groundwater represents an REC.

APT conducted a Phase II ESA at the site between July 2001 and March 2002. A total of eight soil borings were advanced across the site using an Earthprobe™, a truck-mounted drilling unit, with attendant soil sampling. Additionally, eight monitoring wells were installed using a mobile drilling rig, with attendant groundwater sampling. Continuous soil coring was performed for geologic and chemical characterization while drilling all soil borings and monitoring wells. All laboratory analyses were performed by Pace Analytical Services, Inc. (Pace) in Indianapolis, Indiana.

All eight soil borings were advanced to the base of the landfill material, which ranged from 8 to 16 feet below the ground surface (BGS). One soil sample was collected for laboratory analysis, from a depth of eight feet BGS in boring GB-3, and analyzed for volatile organic compounds (VOCs) by Method 8260. The analytical results for the soil sample collected from boring GB-3 is presented in Figure 3. A single groundwater screening sample was collected from each soil boring and analyzed for VOCs, semivolatile organic compounds (SVOCs), and priority pollutant list (PPL) metals using SW-846 Methods, 8260, 8270, and 6010/7471, respectively. The analytical results for the groundwater screening samples is presented in figure 4.



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The eight monitoring wells were installed using a mobile drilling rig equipped with hollow stem augers, and have total depths ranging from 13 to 19 feet BGS. The monitoring wells are of "stick up" design and each well was constructed using two inch diameter polyvinyl chloride (PVC) inner casing and screen materials, and a stainless steel locking outer casing. All wells are screened across the uppermost water bearing strata. A single groundwater sample was collected from each monitoring well and analyzed for VOCs, SVOCs, and PPL metals using SW-846 Methods 8260, 8270, and 6010/7471, respectively. The groundwater analytical results are presented in Figure 5.

The results of the Phase II ESA indicated that:

- Groundwater is encountered at depths ranging from approximately 11 to 16 feet BGS;
- Groundwater flow is toward the west and appears to be in hydraulic connection with Trail Creek;
- Soils in the vicinity of soil boring GB-3 are slightly impacted by VOCs, with methylene chloride being detected at a concentration exceeding its VRP Tier II non-residential cleanup criterion;
- Groundwater at six of the eight soil boring locations and seven of the eight monitoring well locations is impacted by VOCs, at concentrations typically below VRP Tier II non-residential cleanup criteria. The sole exception was the detection of chloroethane in a groundwater sample collected from monitoring well MW-4 (see Figure 2) at a concentration exceeding its VRP Tier II non-residential cleanup criterion;
- Groundwater at one of the eight soil boring locations and five of the eight monitoring well locations is impacted by SVOCs. However, all detected SVOCs were at concentrations below VRP Tier II non-residential cleanup criteria;
- Groundwater at five of the eight soil boring locations and five of the eight monitoring well locations is impacted by one or more PPL metals at concentrations exceeding VRP Tier II non-residential cleanup criteria.

A meeting with the IDEM was held on August 7, 2002 to discuss the results of the Phase II ESA and develop a strategy for further characterization of the site leading to closure. The proposed strategy, which is presented in this SAP, includes the following elements:

- Install an additional monitoring well on an adjacent property across Trail Creek from existing monitoring well MW-4 in order to evaluate the potential for VOC impacts;
- Re-sample all eight on-site monitoring wells to further evaluate the degree of metals impact. Groundwater samples will be collected using a low-flow sampling technique to minimize suspended solids in the sample. Groundwater samples will be collected from the eight on-site monitoring wells on a quarterly basis for eight consecutive quarters in order to verify constituent concentrations and characterize groundwater quality variations over a two year baseline period. All samples will be analyzed for VOCs, SVOCs, and PPL metals. During the first quarter of sampling, each groundwater sample collected for PPL metals analysis will be split, with one portion being filtered and the remaining portion being unfiltered;



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- Soil borings will be advanced on a random basis across the site, with attendant soil sampling, sufficient to characterize the surface and subsurface soils at the site. The soil boring locations will be determined by gridding the site and randomly selecting boring coordinates within the gridded area. Soil samples will be analyzed for VOCs, SVOCs, and PPL metals.
- Perform a baseline surface water and sediment sampling, and analyses in order to characterize surface water quality entering the property from off-site areas, to characterize the water quality at various points within the interior of the property, and to characterize the water quality downstream property (i.e., water quality leaving the site). Surface water samples will be analyzed for VOCs and SVOCs. Sediment samples will be analyzed for SVOCs, PPL metals, and polychlorinated biphenyls (PCBs); and
- Conduct surface water sampling and analyses on a quarterly basis for four consecutive quarters in order to provide water quality data on a seasonal basis and to meet the IDEM requirements for completion sampling. The surface water samples will be analyzed for VOCs and SVOCs.



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### 3.0 GENERAL INFORMATION

The area to be investigated is the former Karwick Road Landfill site and environs. Soil, groundwater, surface water, and sediment samples will be collected by APT personnel during the site investigation activities. Sampling will not be conducted during inclement weather, with inclement weather defined as weather that may impair the integrity of the samples. A copy of the SAP will accompany the sampling team during each sampling event.

All soil, groundwater, surface water, and sediment samples will be analyzed by Pace Analytical of Indianapolis, Indiana (Pace), with the analyses performed in accordance with the most recent edition of the EPA publication SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods." Pace's quality assurance plan (QAP) is included as Appendix D of the multi-site *Quality Assurance Project Plan* (APT, April 2002), which has been developed as a separate document.



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## 4.0 EQUIPMENT AND MATERIALS REQUIRED

The following is a listing of sampling equipment that is planned on being used during the investigative soil and groundwater sampling:

- Truck-mounted or ATV drilling rig with steel alloy hollow-stem augers and drill rods;
- A continuous soil sampler consisting of a split, 2-foot by 2-inch steel tube;
- A scale suitable for use in the field capable of measuring in 0.01-gram increments;
- Certified steel or brass tare weight of known mass (for calibration);
- An Organic Vapor Meter (OVM) with 100 parts per million by volume (ppmv) isobutylene calibration gas;
- Decontaminated stainless steel spatula, utility knife, hand trowel, etc.;
- Decontaminated scoop sampler or bucket hand auger;
- Decontaminated glass or nalgene beaker;
- For groundwater elevation measurement, a Slope Indicator Company Water Level Indicator, graduated in hundredths of a foot;
- A portable pH/ORP/°C/μS Watertest meter suitable for use in the field, and related calibration solutions;
- Survey instrumentation;
- A single stage submersible whale pump equipped with flexible polyethylene tubing and a gate valve (for low flow groundwater sampling);
- Dedicated, disposable, polyethylene bailers and string;
- Disposable 5 micron filters;
- Deionized water and non-phosphate detergent for decontamination;
- New, disposable, clean vinyl, nitrile, or latex gloves;
- New, appropriately sized, pre-preserved sample containers supplied by the laboratory;
- Five-gallon plastic buckets to be used for decontamination of equipment as needed;
- Insulated coolers, capable of maintaining samples at 4 degrees Celsius, for transporting the samples to the laboratory;
- Sealable plastic baggies for packaging and refrigeration of samples;
- Water resistant sample labels;
- A hardbound field logbook;
- Chain-of-custody forms and custody seals;
- Plastic sheeting, paper towels, garbage bags, indelible ink pen, etc.; and



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- A copy of the QAPP on site with the samplers.

Sampling equipment will not be allowed to come in contact with the ground or any object that might provide a source of contamination once it has been decontaminated.



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## **5.0 EQUIPMENT INSPECTION AND CALIBRATION**

Equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specification. In order to insure and maintain operational condition of the sampling and monitoring equipment to be used during field activities, sampling equipment inspection and calibration procedures will be followed during site activities. In addition, an outline of procedures for using and changing gloves to ensure sample integrity during sample collection has also been included.

Standard preventative maintenance plans are established for all field equipment. This includes decontamination of field analytical equipment, including the OVM, Watertest meter, and survey instrumentation. All scheduled and unscheduled maintenance will be recorded in the field notebook.

### **5.1 EQUIPMENT INSPECTION**

Equipment to be used during the field sampling will be examined prior to use to certify that it is in operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to ensure that maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notation on any prior equipment problems are not overlooked, and all necessary repairs to equipment have been carried out.

Sampling equipment will be inspected at least one (1) week prior to each sampling event. A copy of the equipment list in Section 4.0 of this SAP is intended to be used as an inspection schedule and shows the items to be included in the inspection. The copy of the list will be used to document the inspection. Any problem or concern related to the condition of the equipment will be corrected prior to performance of field activities.

The groundwater monitoring wells will be inspected during each groundwater sampling event for any signs of deterioration or other problems (e.g., rusted or broken locks, crumbling or cracked surface pad, missing well cap, standing water). The condition of each monitoring well will be documented in the Field Logbook.

The hollow-stem continuous sampler will be inspected in the field prior to each sampling event. Hollow stem drilling and push-probe equipment will be provided and operated by Top Flight Environmental Drilling of Osceola, Indiana under the direction of APT.

### **5.2 EQUIPMENT CALIBRATION**

Calibration of field instruments is governed by the specific standard operating procedure (SOP) for the applicable field analysis method, and such procedures take precedence over the following general discussion. Additional calibrations will be performed in the event of suspected equipment malfunction.



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Calibration of field instruments will be performed at least twice daily, at the beginning and end of every workday, unless the manufacturer specifies more frequent intervals. Equipment calibration will occur more frequently as conditions dictate. Field instruments will include a portable OVM and a Watertest meter. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be replaced or repaired before being used.

The OVM instrument will be calibrated in the field at the beginning and end of each day of sampling using a 100 ppmv isobutylene calibration gas. Acceptable results of the OVM verification check should be plus or minus 10 percent of the true value of the calibration gas. The OVM instrument will be recalibrated if the result of the verification check is outside of acceptable limits and as necessary in response to any malfunction or anomalous behavior of the instrument. Equipment calibration will be performed to manufacturers' instructions. If equipment malfunction is suspected and calibration failure occurs, equipment will be removed from service and substitute equipment obtained. Documentation of field calibration of the OVM instrument will be recorded in the Field Logbook.

The scale used to weigh the sample will be zeroed by placing a clean calibration mass on the scale and calibration of the scale will continue following the manufacturer instructions.

The Watertest meter will be calibrated in the field at the beginning and end of each day of sampling. Re-calibration will be conducted as necessary in response to any instrument malfunction or anomalous behavior of the instrument. Equipment calibration will be performed according to manufacturer instructions. Documentation of field calibration of the pH, specific conductivity, and temperature meter will be recorded in the Field Logbook.



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## 6.0 TARGET PARAMETERS/ANALYTICAL METHODS

Since the site was used as a municipal landfill and there is no available documentation regarding the exact types of waste accepted at the landfill, the constituents of concern (COCs) encompass a wide range of analytes, including VOCs, SVOCs, and PPL metals. The analyses of soil and groundwater samples collected by APT personnel during site investigation activities conducted July 2001 through March 2002 indicate the presence of all of these analytes.

Future soil and groundwater samples will be analyzed for:

- VOCs by SW-846 Method 8260;
- SVOCs by SW-846 Method 8270 (base/neutrals/acids); and
- PPL metals by SW-846 Methods 6010 and 7470/7471 (mercury).

Additionally, surface water samples will be analyzed for VOCs by SW-846 Method 8260 and SVOCs by SW-846 Method 8270 (base/neutrals/acids). Sediment samples will be analyzed for SVOCs by SW-846 Method 8270 (base/neutrals/acids), PPL metals by SW-846 Methods 6010 and 7471, and PCBs by SW-846 Method 8082.

Soil samples to be analyzed for VOCs will be collected in accordance with Method IN5035-M: each soil sample will be weighed for the appropriate amount and transferred into the appropriate sample container by using a gloved hand and/or spatula. If no soil sample analyses are to be performed, the collected soil sample(s) will be discarded.

Further details pertaining to laboratory methods and data quality objectives are presented in the laboratory's QAP, which is included as Appendix D of the multi-site QAPP (APT, June 2002).



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## 7.0 USE OF GLOVES

Any personnel handling the equipment or performing sampling will wear a new pair of clean latex, nitrile, or vinyl gloves if the potential exists for contact with the soil or groundwater sample, or any surface that may come in contact with the sample. Gloves must be discarded after each sample interval and replaced with new, clean gloves prior to proceeding to the next sample interval. Gloves will be collected with other personal protection equipment (PPE), containerized in a labeled 55-gallon drum, and characterized for appropriate disposal. Characterization of PPE will rely on the laboratory results of the soil samples tested. Sampling equipment and the samples themselves will not be allowed to come in contact with any object that might provide a source of contamination.



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## 8.0 SOIL SAMPLING

Soil samples will be collected for laboratory analysis. Soil borings will be advanced using a truck-mounted drilling rig equipped with hollow stem augers and split-spoon samplers. Continuous soil cores will be collected in order to characterize the subsurface according to the procedure outlined in Section 8.2 of this SAP.

Two soil samples, one surface and one subsurface soil sample, will be collected from each boring for laboratory analyses. The surface soil sample (defined by the VRP as within the uppermost two feet) will be collected from a depth of one foot BGS in each boring. The subsurface soil sample will be collected from the interval exhibiting the highest degree of apparent impact based on OVM readings or visual observations, or if there is no evidence of impact, from just above the capillary fringe of the water table. Soil samples to be analyzed for VOCs will be collected in accordance with Method IN5035-M: each soil sample will be weighed for the appropriate amount and transferred into the appropriate sample container by using a gloved hand and/or spatula. Soil samples to be analyzed for other parameters will be stored in appropriate containers supplied by the laboratory. The laboratory will analyze soil samples for the analytical parameters specified Section 6.0 of this *Sampling and Analysis Plan*.

An estimated 75 percent of both the surface and subsurface soil samples collected for laboratory analysis will follow the VRP's data quality objectives (DQOs) for site investigation sampling (*i.e.*, Level 3 DQOs). The remaining 25 percent, which will be randomly selected, will follow the VRP's DQO's for confirmation sampling (*i.e.*, Level 4 DQOs) so that they may be used for site closure purposes.

### 8.1 SAMPLE LOCATIONS

An estimated 40 soil borings will be advanced at the site. All borings will be advanced to a total depth of approximately one to two feet into the zone of saturation, which occurs at depths ranging from seven to more than ten feet BGS. The soil boring locations will be determined using the following procedure:

- The site will be divided into four more or less equal-sized quadrants;
- Each quadrant will be further subdivided using 25-foot square grids;
- Ten (x,y) coordinate pairs will be selected for each quadrant using a random number generator or random number tables.

Dividing the site into four quadrants will ensure that the entire site is adequately investigated, while the random location selection process will allow for a non-biased sampling approach. The proposed soil boring locations are shown in Figure 6.

### 8.2 HOLLOW-STEM AUGER SOIL SAMPLING PROCEDURE

A mobile rig equipped with hollow-stem augers operates by continuously advancing ahead of the auger bit a two-foot long, 2-inch diameter split-spoon sampler attached to the bottom of 2-inch



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diameter steel alloy drill rods. The split-spoon sampler is a split hollow steel tube measuring two feet in length. The split-spoon sampler is advanced by repeatedly dropping a "hammer" a fixed distance onto the drive head of the sampling chain until it has been advanced an incremental distance of two feet.

Continuous soil cores will be retrieved from the monitoring well borings to geologically and chemically characterize the soils and observe the soils for unusual conditions. The following procedure will be followed while advancing each borehole:

1. The drill rig will be moved to the designated sampling location. Any deviation from the sample locations identified in this SAP, along with the reasons for the location change, will be documented in the Field Logbook.
2. The drilling equipment will be set up and a decontaminated two-foot long, 2-inch diameter split-spoon sampler will be advanced ahead of the auger bit in accordance with ASTM Standard Method D1586-84; each sample core will be taken with a vertical orientation. After being advanced to the desired sampling depth, the sampler will be withdrawn and the soil core removed for inspection.
3. The soil core will be placed on clean plastic sheeting and opened by splitting the sampler in half for direct observation of the soil sample.
4. The soil core will be field screened for VOCs using an OVM equipped with a photoionization detector. OVM measurements will be recorded in the logbook or on a Soil Boring Log form.
5. A single surface soil sample will be collected from a pre-determined depth of one foot BGS in each boring. A single subsurface sample will also be collected from each boring, based on visual observations, OVM measurements, or from just above the capillary fringe if no evidence of impact is noted in the boring. Additional soil samples may be collected at the discretion of the field geologist based on field observations. Samples to be analyzed for VOCs will be collected in accordance with Method IN5035-M: each soil sample will be weighed for the appropriate amount and transferred into the appropriate sample container by using a gloved hand and/or spatula. In the event that additional soil samples (other than one surface and one subsurface sample) are collected, the Michigan City Economic Development Corporation (MCEDC) will be contacted with regard to whether analysis should be performed on the additional sample(s). If not, the additional soil sample(s) will be discarded.
6. If the sample is to be submitted to the laboratory for analyses, a sample number will be assigned to that sample and all appropriate information will be recorded in the Field Logbook. Soil sample locations and intervals will be recorded in the Field Logbook or on a Soil Boring Log form using the appropriate sample identifier as discussed in Section 14 of this SAP.
7. The soil core will then be geologically characterized by the on-site geologist. The geologic observations and stratigraphic information will be recorded in the logbook or on a Soil Boring Log form.



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8. The auger chain will then be advanced to the bottom depth of the split-spoon sampler and the process repeated until the total depth of the boring is reached.
9. Following sampling activities, the chain-of-custody form will be completed and sample containers placed in an ice-filled cooler for storage. Samples will be packaged and protected to reduce the potential for breakage and cross-contamination. Appropriate chain-of-custody procedures will be maintained. Sample labels are to be completed for each sample container as outlined in Section 14 of this SAP.

Following completion of each boring, the open borehole will be properly abandoned by filling it with bentonite or grout. Soils and decontamination liquids generated during drilling activities will be placed in labeled 55-gallon drums for appropriate characterization and disposal as necessary.



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## 9.0 GROUNDWATER SAMPLING

Previous groundwater sample analyses indicated the presence of various metals and one VOC (chloroethane) at concentrations exceeding VRP Tier II non-residential cleanup criteria. In order to further characterize the groundwater quality at the former Karwick Road Landfill site, groundwater assessment activity is proposed. This section lists the procedures to be followed so that any qualified individual can obtain representative groundwater samples from monitoring wells.

The groundwater sampling activity consists of baseline groundwater monitoring on a quarterly basis over a one-year period. The eight existing on-site monitoring wells will be sampled using a low flow sampling technique, with analysis for PPL metals, in order to verify previous sampling and analysis results. The locations of the eight on-site monitoring wells are shown on Figure 2. During the first quarter of groundwater sampling, each sample collected for PPL metals analysis will be split with one portion being filtered and the remaining portion being unfiltered. Groundwater samples will be collected from the monitoring wells in the following order: least impacted to most impacted based on previous analytical data.

Additional monitoring wells may be warranted in future phases of site investigation activity. The locations of additional monitoring wells, if warranted, will be based on the results of the existing soil and groundwater data, future screening data, and site conditions. Any new monitoring wells will be located such that they are adequate to evaluate site-wide groundwater with regard to the potential for impact.

Groundwater sampling at the site will include:

- Collecting groundwater samples from the eight on-site monitoring wells on a quarterly basis for four consecutive quarters, with analyses for VOCs, SVOCs, and PPL metals using Method 8260, Method 8270, and Methods 6010/7471 respectively. The resulting groundwater quality data is intended to be used to characterize groundwater quality at the site over a one-year baseline period, and may be used for closure purposes under the VRP. Thus, these samples will be collected following the VRP DQOs for completion sampling (*i.e.*, Level 4 DQOs); and

The least impacted wells (based on existing data) will be sampled first, and the most impacted wells will be sampled last. Quality assurance/quality control (QA/QC) samples will also be collected in accordance with IDEM requirements, and will include one duplicate sample per every 10 investigative samples, one equipment rinsate blank per day, one matrix spike/matrix spike duplicate (MS/MSD) per 20 investigative samples, and one trip blank per sample shipping container.

Soils and decontamination liquids generated during drilling activities will be placed in labeled 55-gallon drums for appropriate characterization and disposal as necessary. Soil sampling equipment will be decontaminated between soil cores using non-phosphate detergent and distilled water.



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*one well will  
be installed  
now*

## 9.1 MONITORING WELL INSTALLATION PROCEDURE

If additional monitoring wells are required at some future date, these monitoring well borings are anticipated to be advanced to a depth of approximately three to five feet into the zone of saturation, estimated to occur at a depth of 10 to 20 feet BGS depending on the location within the site. Continuous soil cores will be retrieved from the monitoring well borings to geologically and chemically characterize the soils and observe the soils for unusual conditions.

The following procedure will be followed while advancing monitoring well borings:

1. The drill rig will be moved to the designated sampling location. Any deviation from the sample locations identified in this SAP, along with the reasons for the location change, will be documented in the Field Logbook.
2. The drilling equipment will be set up and a decontaminated two-foot long, 2-inch diameter split-spoon sampler will be advanced ahead of the auger bit in accordance with ASTM Standard Method D1586-84; each sample core will be taken with a vertical orientation. After being advanced to the desired sampling depth, the sampler will be withdrawn and the soil core removed for inspection.
3. The soil core will be placed on clean plastic sheeting and opened by splitting the sampler in half for direct observation of the soil sample.
4. The soil core will then be field screened for VOCs using an OVM equipped with a photoionization detector. OVM measurements will be recorded in the logbook or on a Soil Boring Log form. Although no soil samples are proposed to be collected from monitoring well borings, soil samples may be retained for possible laboratory analysis based on the OVM readings or visual evidence of impact. Samples to be analyzed for VOCs will be collected in accordance with Method IN5035-M: each soil sample will be weighed for the appropriate amount and transferred into the appropriate sample container by using a gloved hand and/or spatula. The MCEDC will be contacted with regard to whether analysis should be performed. If not, the collected soil sample will be discarded.
5. If the sample is to be submitted to the laboratory for analyses, a sample number will be assigned to that sample and all appropriate information will be recorded in the Field Logbook. Soil sample locations and intervals will be recorded in the Field Logbook or on a Soil Boring Log form using the appropriate sample identifier as discussed in Section 14 of this SAP.
6. The soil core will then be geologically characterized by the on-site geologist. The geologic observations and stratigraphic information will be recorded in the logbook or on a Soil Boring Log form.
7. The auger chain will then be advanced to the bottom depth of the split-spoon sampler and the process repeated until the total depth of the boring is reached.
8. Following sampling activities, the chain-of-custody form will be completed and sample containers placed in an ice-filled cooler for storage. Samples will be packaged and protected to reduce the potential for breakage and cross-contamination. Appropriate



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chain-of-custody procedures will be maintained. Sample labels are to be completed for each sample container as outlined in Section 14.

9. Following completion of each boring, a monitoring well will be constructed per the procedure outlined below.
10. Following installation, each monitoring well will be developed using the procedure described in Section 9.3 of this SAP.

The following procedure will be followed when installing monitoring wells:

1. The monitoring well borehole will be advanced to its total planned depth using a mobile drilling rig equipped with 4-1/4 inch hollow stem augers. The wellbore will be terminated upon reaching a depth sufficient to install a five-foot long screen across the static water level of the uppermost water bearing zone. This will allow for the detection of possible light non-aqueous phase liquids (LNAPL) under a range of groundwater elevation fluctuations;
2. The monitoring well will be installed inside of the auger chain using a five-foot long slotted screen and five-foot long sections of flush-threaded 2-inch PVC. The monitoring well will be equipped with a pro cover stick-up casing for ease of location;
3. A filter pack of appropriately sized material will be placed from the bottom of the wellbore to two feet above the top of the screen. The filter pack will not extend more than two feet above the top of the well screen;
4. An annular seal of bentonite shall be installed above the filter pack and will have a minimum thickness of two feet;
5. A annular seal of bentonite or grout (if the bentonite does not extend upward through the remaining annular space to the base of the concrete surface seal) shall be installed above the bentonite seal and will extend upward to the base of the concrete surface seal;
6. A concrete surface seal will be installed and will be anchored to soils below the regional frost line to protect the well from damage due to frost heave;
7. A concrete pad will be installed around the monitoring well and will be sloped away from the well casing to deflect surface water away from the well;
8. The newly installed monitoring well casing will be surveyed to a vertical accuracy of 0.01 feet and a horizontal accuracy of 1.0 feet, relative to a permanent on-site benchmark; and
9. A well construction diagram will be completed for each monitoring well, providing pertinent information regarding the well.
10. The filter pack, annular seal, and grouting materials shall be installed through the center of the hollow-stem auger chain as the drill string is withdrawn. Filter pack materials and bentonite chips or pellets will be introduced gradually and uniformly to the annular space inside of the hollow-stem auger chain and around the well casing to prevent bridging of the materials during placement. The auger chain will be gradually removed from the open borehole in approximately one-foot lifts as the material is placed, allowing the



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material to gradually spill out of the bottom of the auger chain into the annular space between the subsurface soils and the well casing and thus further prevent bridging. Any grouting will occur under pressure with the annulus sealed from the bottom up via the tremie method.

## **9.2 MEASUREMENT OF STATIC GROUNDWATER ELEVATIONS**

All wells will be purged and sampled using a low flow technique. Prior to purging the wells when sampling, the depth to water will be determined by utilizing a decontaminated electronic water level indicator with a weighted probe. Upon opening each well (i.e., removing the sealed cap), the water elevations will be gauged repeatedly and the measured elevations recorded in the field logbook. When the trends of at least three consecutive measurements are within 0.01 feet of one another the well will be considered to have equilibrated. Upon reaching apparent equilibrium, the monitoring well will be allowed to equilibrate for an additional five minute time period as a safety factor.

Measurements will then be taken using an electronic water level indicator, to an accuracy of 0.01 feet. The reference point for the measurement is a mark at the top of the well casing. The elevations of these reference points will be surveyed relative to a permanent local benchmark. The elevation of the groundwater in each well will be determined by subtracting the depth-to-water measurement from the measuring point elevation. All survey and water elevation measurements will be recorded in the Field Logbook.

## **9.3 MONITORING WELL PURGING AND SAMPLING PROCEDURE**

The following procedure will be followed when sampling groundwater from monitoring wells:

1. The least impacted wells (based on existing data) will be sampled first, and the most impacted wells will be sampled last.
2. The sampler will don new, clean, disposable, latex sampling gloves when performing sampling activities at each well location.
3. Prior to collecting a groundwater sample from a monitoring well, a minimum of three well casing volumes of water will be purged from the monitoring well. A well casing volume will be calculated by subtracting the depth-to-water from the total depth of the well and multiplying the difference by 0.163 gallons per foot (gal/ft). The pH, temperature, and specific conductivity of the groundwater will be measured in the field on five minute intervals. A maximum of five well volumes will be purged from a monitoring well if the pH, temperature, and specific conductivity does not stabilize in accordance with the following criteria:
  - pH:  $\pm 0.1$  standard units;
  - temperature:  $\pm 0.5^{\circ}\text{C}$ ; and
  - specific conductivity:  $\pm 10$  percent.



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Purge water from the monitoring wells will be collected in 5-gallon buckets during purging and sampling. The purge water will be transferred to a properly designated and labeled 55-gallon drum for disposal at a later date.

4. The following sampling order will be followed:
  - VOCs;
  - SVOCs; and
  - PPL metals.
5. A single stage submersible whale pump equipped with disposable flexible polyethylene tubing and a gate valve will be used to collect groundwater samples. The pump will be gently lowered into the standing water within the monitoring well to a point approximately two feet above the bottom of the well, or to a depth sufficient to avoid sediment that may have settled at the bottom of the well casing. The pump will then be started and the flow adjusted using the gate valve. Groundwater samples will be transferred directly from the pump's discharge stream into laboratory supplied, pre-preserved sample containers. Samples for VOCs will be filled such that there is no headspace in the sample container. Filtered samples (metals analysis) can be collected by attaching the pump discharge tubing directly to the filter, and the filtered sample collected from the filter discharge port.
6. The groundwater samples will be immediately placed into a pre-chilled sample cooler containing ice.
7. Upon completion of the sampling activity at each well, the cap will be replaced and the well locked.

Sample bottles, analytical methods, preservatives, and holding times are specified in the following sections of this SAP and in Table 1. Three 40-milliliter (ml) vials, pre-preserved with HCl at the laboratory; two 1-liter (L) amber bottles; and one 150-mL plastic bottle, pre-preserved with HNO<sub>3</sub> at the laboratory will be used as the sampling containers for samples to be analyzed for VOCs, SVOCs, and metals, respectively. It is desirable to label all the bottles prior to sampling or to pre-label a complete set of bottles for a well prior to sampling the well. Dedicated bailers, twine, and tubing will be used to purge/sample each well; bailers, twine, or tubing will not be re-used.



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## 10.0 SURFACE WATER SAMPLING

In order to characterize the surface water quality both off-site and on-site, surface water sampling will be conducted in two phases: baseline and verification sampling. Baseline surface water sampling and analyses will be conducted in order to characterize surface water quality entering the property from off-site areas, to characterize the water quality at various points within the interior of the property, and to characterize the water quality downstream of the property (i.e., water quality leaving the site). Following the baseline assessment, surface water sampling and analyses will be conducted on a quarterly basis for four consecutive quarters in order to provide water quality data on a seasonal basis and to meet the IDEM requirements for completion sampling.

Surface water samples will be collected from Trial Creek and Cheney Run during the baseline surface water assessment and during the verification sampling. A total of ten surface water samples will be collected during the baseline assessment, while six samples will be collected during each quarterly sampling event. The proposed surface water sampling locations are shown in Figure 6. All surface water samples will be analyzed for VOCs and SVOC. Most samples taken during site investigations will be grab samples. Typically, surface water sampling involves immersing the sample container directly in the body of water.

The farther downstream surface water sample will be collected first, with the remaining samples taken while moving progressively upstream. Care will be taken to minimize sediment disturbance while collecting surface water samples. Sediment samples will be collected after the corresponding surface water sample.

Samples may be collected either by immersing the approved sample container, a glass, or nalgene beaker into the water. Sample bottles (or beakers) will be rinsed at least once with the water (except for VOC samples, which are collected in pre-preserved sample vials) to be sampled prior to sample collection. Care will be taken to avoid excessive agitation of the water, which may result in the loss of volatile constituents. Additionally, samples for volatile organic analyses will be collected first, followed by the samples for other constituents in decreasing order of volatility. Measurements for temperature, pH, specific conductance or other field parameters, as appropriate, will be collected from an unpreserved container immediately following the collection of samples for laboratory analyses. Either a nalgene or glass beaker will be used to collect samples for VOC analysis. Water collected using the nalgene or glass beaker will be transferred into the pre-preserved 40-ml vials. Metals samples will be unfiltered (total metals) rather than filtered (dissolved metals).

When obtaining samples in 40-ml vials for volatile organic analysis, it is important to exclude any air space in the top of the bottle and to be sure that the Teflon liner faces inward. The bottle will be turned upside down to check for air bubbles after the bottle is filled and capped.

The sampling locations will be marked via wooden stake placed at the nearest bank or shore. The sampling location number will be marked with indelible ink on the stake.



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Samples will not be collected at the surface unless sampling specifically for a known constituent which is immiscible and on top of the water. Instead, the sample container should be inverted, lowered to the middle of the water column, and held at about a 45 degree angle with the mouth of the bottle facing upgradient. A detailed description of this technique, known as dip sampling, is described in Section 10.3 of this *Sampling Analysis Plan*.

## 10.1 BASELINE SURFACE WATER ASSESSMENT

During the baseline assessment, 10 surface water samples will be collected from Trail Creek and Cheney Run as follows:

- Four background surface water will be collected, two each from upstream, off-site areas of Trail Creek and Cheney Run, respectively;
- One surface water sample will be collected from Trail Creek at the upstream property boundary of the site;
- One surface water sample will be collected from Cheney Run at the upstream property boundary of the site;
- One surface water sample will be collected from Trail Creek just upstream of where Trail Creek and Cheney Run become confluent;
- One surface water sample will be collected from Trail Creek just downstream of where Trail Creek and Cheney Run become confluent;
- One surface water sample will be collected from Trail Creek, midway between where Trail Creek and Cheney Run become confluent and where Trail Creek exits the site; and
- One surface water sample will be collected from Trail Creek at the downstream property boundary of the site.

The surface water samples will all be analyzed for VOCs and SVOCs by SW-846 Methods 8260 and 8270, respectively. All analyses and analytical reports will be consistent with VRP Level 4 DQOs, consistent with IDEM closure requirements.

## 10.2 QUARTERLY SURFACE WATER SAMPLING

Surface water samples are to be collected on a quarterly basis for four consecutive quarters. A total of six (6) surface water samples will be collected from Trail Creek and Cheney Run as follows:

- One surface water sample will be collected from Trail Creek at the upstream property boundary of the site;
- One surface water sample will be collected from Cheney Run at the upstream property boundary of the site;
- One surface water sample will be collected from Trail Creek just upstream of where Trail Creek and Cheney Run become confluent;



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- One surface water sample will be collected from Trail Creek just downstream of where Trail Creek and Cheney Run become confluent;
- One surface water sample will be collected from Trail Creek, midway between where Trail Creek and Cheney Run become confluent and where Trail Creek exits the site; and
- One surface water sample will be collected from Trail Creek at the downstream property boundary of the site.

The surface water samples will all be analyzed for VOCs and SVOCs by SW-846 Methods 8260 and 8270, respectively.

Additionally, the following quality assurance/quality control (QA/QC) samples will be collected:

- Water samples: one duplicate (VOCs and SVOCs analyses), one trip blank (VOCs), and one MS/MSD per sampling event for VOCs and SVOCs analyses.

All analyses and analytical reports will be consistent with VRP Level 4 DQOs, consistent with IDEM closure requirements.

### 10.3 SURFACE WATER SAMPLING PROCEDURE

Surface water samples will be collected by filling a container, either attached to a pole or held directly, from the midpoint of the water column (i.e., halfway between the surface and the bottom of the water body). If it is necessary to wade into the water body to obtain a sample, the sampler will be careful to minimize disturbance of bottom sediments and must enter the water body downstream of the sampling location. If necessary, the sampling technician will wait for the sediments to settle before taking a sample. The following procedure will be followed while collecting each surface water sample:

1. The sampler will don new, clean, disposable, latex sampling gloves when performing sampling activities at each surface water sample location.
2. The sampler will immerse the approved sample container or a glass or nalgene beaker into the water taking care to avoid excessive agitation of the water. Sample bottles (or beakers) will be rinsed at least once with the water to be sampled prior to sample collection, except for VOC sample bottles, which contain preservative and thus will not be immersed into the water.
3. VOCs will be collected first, followed by SVOCs.
4. A beaker will be used to collect the surface water sample for VOC analysis. The collected surface water will be transferred from the beaker into the appropriate sample containers. Samples for VOCs will be filled such that there is no headspace in the sample container.
5. The pH, temperature, and specific conductivity of the surface water will be collected from an unpreserved container immediately following collection of the samples for laboratory analyses.



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6. The surface water samples will be immediately placed into a pre-chilled sample cooler containing ice.

Sample bottles analytical methods, preservatives, and holding times are specified in the following sections of this SAP and in Table 1. Three 40-ml vials, pre-preserved with HCl at the laboratory, and two 1-L amber bottles will be used as the sampling containers for samples to be analyzed for VOCs, and SVOCs, respectively. It is desirable to label all the bottles prior to sampling or to pre-label a complete set of bottles for a well prior to sampling the well.

Beakers will be cleaned between each surface sample location using the procedure described in Section 13.0 of this *Sampling Analysis Plan*.



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## 11.0 SEDIMENT SAMPLING

Sediment samples will be collected from Trial Creek and Cheney Run during the baseline surface water and sediment assessment. As with surface water samples, sediment samples should be collected from downstream to upstream. Sediment samples may be obtained using any of the on-shore or off-shore techniques described below, depending upon site conditions.

The following samplers may be used to collect bottom materials:

- Stainless steel spoon or trowel
- Scoop sampler
- Bucket hand auger

For loosely packed sediments, a stainless steel spoon or trowel can be used to collect a representative sample in narrow intermittent streams, tidal flats, or wetlands. However, this sampling method may not be practical at the Karwick Road site due to the depth of the surface water body.

A second method of sediment collection consists of using a scoop sampler, the easiest and "cleanest" way to collect a sediment sample. This method is accomplished by reaching over or wading into the water body and, while facing upstream (into the current), scooping in the sample along the bottom in the upstream direction. Alternatively, the scoop sampler can be attached to a pole. The pole may be made of bamboo, wood or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

Another method of collecting sediment samples is to use a bucket hand auger. Bucket hand augering is a viable method for collecting sediment samples in narrow, intermittent streams, tidal flats, or wetlands. Typically, a four-inch diameter auger bucket with a cutting head is pushed and twisted into the ground and removed as the bucket is filled. The auger hole is advanced one bucket at a time, to a specified depth.

When a specific vertical sampling interval is required, one auger bucket is used to advance the auger hole to the first desired sampling depth. If the sample at this location is to be a vertical composite of all intervals, the same bucket may be used to advance the hole, as well collect subsequent samples in the same hole. However, if discrete grab samples are to be collected to characterize each depth, a new bucket must be placed on the end of the auger extension immediately prior to collecting the next sample. The top several inches of sediment should be removed from the bucket to minimize the changes of cross contamination of the sample from fall in of material from the upper portions of the hole.

Samples will be collected by excavating a sufficient amount of bottom material using a scoop, beaker, spoon, trowel or auger. Samples should be collected with the sampling device facing upstream and the sample collected from downstream to upstream. Care should be taken to minimize the loss of fine grained materials from the sample.



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The sample will be transferred to the appropriate sample containers. Sampling personnel will use judgment in removing large plant fragments to limit bias caused by bio-organic accumulation.

The sampling location will be marked via a wooden stake placed at the nearest bank or shore. The sample location number will be marked on the stake with indelible ink. The following information will be recorded in the field logbook, project location, date and time, weather, sample location number and sample identification number, any flow conditions, a sketch of sampling location including boundaries of water body, sample location, water depth, sample collection depth, relative position with respect to the site, location of wooden identifier stake, and chemical analyses to be performed. The proposed sediment sampling locations are shown in Figure 6.

### **11.1 BASELINE SEDIMENT ASSESSMENT**

During the baseline assessment, 10 sediment samples will be collected from Trail Creek and Cheney Run as follows:

- Four background sediment samples will be collected, two each from upstream, off-site areas of Trail Creek and Cheney Run, respectively;
- One sediment sample will be collected from Trail Creek at the upstream property boundary of the site;
- One sediment sample will be collected from Cheney Run at the upstream property boundary of the site;
- One sediment sample will be collected from Trail Creek just upstream of where Trail Creek and Cheney Run become confluent;
- One sediment sample will be collected from Trail Creek just downstream of where Trail Creek and Cheney Run become confluent;
- One sediment sample will be collected from Trail Creek, midway between where Trail Creek and Cheney Run become confluent and where Trail Creek exits the site; and
- One sediment sample will be collected from Trail Creek at the downstream property boundary of the site.

The sediment will all be analyzed for SVOCs PPL metals, and PCBs by SW-846 Methods 8270, 6010/7471, and 8082, respectively. All analyses and analytical reports will be consistent with VRP Level 4 DQOs, consistent with IDEM closure requirements.



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## 11.2 SEDIMENT SAMPLING PROCEDURE

The following procedure will be followed while collecting each sediment sample:

1. The sampler will don new, clean, disposable, latex sampling gloves when performing sampling activities at each sediment sample location.
2. A clean scoop, beaker, spoon, trowel, or auger will be used to collect the sample from a desired depth. Remove any heavy debris, rocks, and twigs.
3. The following sampling order will be followed:
  - SVOCs;
  - PPL metals; and
  - PCBs.
4. The sediment sample will be transfer to the appropriate sample container.
5. The sediment sample will be immediately placed into a pre-chilled sample cooler containing ice.

Sampling bottles, analytical methods, preservatives, and holding times are specified in the following sections of this SAP and in Table 1. One 4-ounce jar will be used as the sampling container for samples to be analyzed for SVOCs, PPL metals, and PCBs. It is desirable to label a complete set of bottles prior to the collection of sediment samples.

Equipment used for sediment sampling will be decontaminated between sample locations following the procedure outlined in Section 13 of this *Sampling Analysis Plan*.



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## **12.0 QA/QC SAMPLES**

The VRP guidance (IDEM, July 1996) identifies four types of quality control samples are to be collected in the field: trip blanks, equipment rinsate or field blanks, duplicates, and MS/MSDs. Trip blanks are used to document volatile organic contamination attributable to shipping and field handling procedures. Equipment rinsate blanks are obtained from sampling equipment, which has been decontaminated to document the effectiveness of decontamination procedures. The detection of analytes in the equipment rinsate blank indicates possible cross-contamination between sample locations and determines that either ineffective or incomplete decontamination has been performed on equipment from which the equipment rinsate blank was collected. Duplicate samples are used to assess the representativeness (sampling variability) of field sampling procedures. MS/MSDs are used to assess the effect the sample matrix has on the accuracy of the result.

### **12.1 TRIP BLANKS**

To document the absence of VOC contamination attributable to shipping and field handling procedures associated with aqueous samples, a water sample of analyte-free media is prepared by the laboratory, transported to the sampling site, and returned to the laboratory unopened. The trip blank (which is pre-preserved and will remain sealed) is transported to the laboratory along with the investigative samples, and analyzed for VOCs. A minimum of one trip blank will be analyzed per shipping container containing aqueous samples.

Additionally, a methanol blank will be submitted to the laboratory for analysis associated with the soil sampling activities for VOC analysis (Method IN5035). A minimum of one methanol blank will be analyzed per shipping container containing soil samples to be analyzed for VOCs.

### **12.2 EQUIPMENT RINSATE/FIELD BLANKS**

As a check on equipment decontamination procedures, equipment rinsate/field blanks will be prepared from each type of soil sampling device used to collect soil, sediment and groundwater samples. The equipment rinsate/field blank will be prepared by pouring a sufficient volume of deionized water over all of the sampling equipment used to collect samples in the sampling event (e.g., the split-spoon sampler and any utensils used for soil sampling, or the water level meter and any other equipment or utensils coming in contact with groundwater samples).

The equipment rinsate/field blank will be collected in the appropriate sample containers, preserved, transported, and analyzed in the exact manner as the assessment samples. A minimum of one equipment/field blank will be collected and analyzed per ten investigative samples, with no less than one per day of sampling. For this project, it is estimated that eight equipment rinsate/field blanks will be collected during the soil assessment, one equipment rinsate/field blank will be collected for each sampling event during the groundwater assessment, and one equipment rinsate/field blank will be collected during the baseline surface water and sediment assessment.



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### 12.3 DUPLICATES

A minimum of one duplicate will be collected and analyzed per ten investigative samples, per media, with no less than one per media for each sampling event. For this project, it is estimated that eight duplicate soil samples (four surface soil and four subsurface soil samples) will be collected during the soil assessment phase of the site investigation, and a total of four groundwater duplicate samples will be collected during the four-quarter groundwater assessment. A total of five surface water duplicate samples will be collected during the baseline surface water and sediment assessment and the four quarters of surface water sampling. Additionally, it is estimated that one sediment duplicate sample will be collected during the baseline surface water and sediment assessment.

Four surface sample duplicates and four subsurface sample duplicates will be collected during the soil assessment and one duplicate groundwater sample will be collected for each quarterly sampling event during the groundwater assessment to establish the representativeness of field sampling procedures. Additionally, one surface water duplicate and one sediment duplicate will be collected during the baseline surface water and sediment assessment and one duplicate surface water sample will be collected for each quarterly surface water sampling event. The duplicate sample will be prepared by dividing the soil, groundwater, surface water, or sediment sample into two approximately equal portions, one of which is the duplicate sample. The sample and duplicate sample will be filled successively from a selected sample. Additional sample volumes will be collected and split as needed to fill the two (investigative and duplicate) sample containers. The sample bottles for one parameter (e.g., VOCs) will be filled before proceeding to the next parameter or sampling interval. The duplicate sample is placed in the appropriate container using the same procedure as for investigative samples, and subjected to the same analyses as the investigative sample.

### 12.4 MATRIX SPIKE/MATRIX SPIKE DUPLICATE

In order to document both the bias and the precision of a method in a given sample matrix, enough volume of one sample of each media will be collected to prepare a matrix spike (MS) and a matrix spike duplicate (MSD) each time samples are collected.

A minimum of one MS/MSD will be collected and analyzed per twenty investigative samples, per media, with no less than one per media for each sampling event. For this project, it is estimated that four soil MS/MSD samples will be collected during the soil assessment phase of the site investigation, and one groundwater MS/MSD sample will be collected during each quarterly groundwater sampling event during the groundwater assessment. One surface water MS/MSD sample will be collected during the baseline surface water and sediment assessment and during each quarterly surface water sampling event. Additionally, one sediment MS/MSD sample will be collected during the baseline surface water and sediment assessment. The selected soil, groundwater, surface water, or sediment sample for MS/MSD analysis will be divided into two more or less equal portions and placed in their respective sample bottles. Additional sample volumes will be collected and split as needed to fill the two sample containers.



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### 13.0 DECONTAMINATION OF FIELD EQUIPMENT

Only thoroughly decontaminated equipment will be used to collect samples during the investigative activities. If dedicated factory sealed bailers are used for groundwater sampling, no decontamination will be required for this equipment item. The hollow stem augers will be decontaminated using a pressurized steam cleaner to wash off all visible soil/residues.

The following decontamination procedures will be used for all other sampling equipment, including the hollow-stem auger continuous sampler, the push-probe sampling tools, the water level indicator, and any other non-disposable sampling equipment that might come in contact with the soil, groundwater, or sediment samples. All such sampling equipment will be decontaminated using these procedures:

1. Prior to decontamination, all sampling equipment will be completely disassembled to the extent feasible.
2. The decontamination procedure will consist of a three-step process which includes a thorough non-phosphate detergent "dirty wash" to remove the majority of the soil, followed by a non-phosphate "clean wash" and triple rinse with distilled water.
3. If visible soil or other residues remain, then procedure 2 will be followed again until all visible soil/residues have been removed from all sampling equipment.
4. The sampling equipment will then be subjected to a final rinse with distilled water.
5. Sampling equipment will be protected from contamination during field operations.



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## 14.0 SAMPLE CONTAINERS AND PRESERVATION

All samples are to be transferred directly into the appropriate new sample containers provided by the laboratory. Only new, pre-preserved (as applicable) sample containers supplied by the analytical laboratory will be used. All sample containers will conform to the specifications of SW-846. The container will be filled with the appropriate amount of soil or water that is determined by the analytical method. The containers will be appropriately sized to contain a sufficient volume of sample for the required analysis. Container descriptions, preservation requirements, and holding times are presented in Table 1.

Soil samples that will be analyzed for VOCs will be stored in three 40-ml vials and one 4-ounce container. One of the 40-ml vials will be pre-preserved with methanol, and the remaining 40-ml vials and 4-ounce container will be non-preserved, consistent with IN-5035M. Soil and sediment samples that will be analyzed for SVOCs, PPL metals, and PCBs will be containerized in 4-ounce glass jars equipped with Teflon lined lids. Preservation will also include packing the samples in an insulated cooler with ice to maintain the samples at a temperature of approximately 4°C.

Groundwater samples, surface water samples, equipment blanks, and trip blanks that will be analyzed for VOCs (SW-846 Method 8260) will be stored in 40-ml vials pre-preserved at the laboratory with HCl. Groundwater, surface water, and QA/QC samples that will be analyzed for SVOCs will be stored in 1-L amber bottles without preservative. Groundwater and QA/QC samples that will be analyzed for PPL metals will be stored in 500-ml plastic bottles pre-preserved at the laboratory with HNO<sub>3</sub>. All samples will be stored and shipped in an insulated cooler with ice to maintain the samples at a temperature of approximately 4°C.



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## 15.0 PACKAGING AND SHIPMENT OF SAMPLES

The filled sample containers (soil, groundwater, surface water, and sediment samples) will be securely packed in an insulated cooler to avoid breakage during shipment. Ice will be placed in pouches such as Ziplock® baggies and packed with the samples in an insulated cooler to maintain the temperature of the samples at 4° C during shipment. All samples will be shipped to the laboratory via overnight courier. Each sample shipment will be accompanied by a chain-of-custody form, which will also identify the requested analyses. All necessary paperwork will be placed in a plastic, sealed bag inside the lid of each cooler and the cooler will be sealed with custody seals and covered by clear shipping tape. Shipping records will be maintained with chain-of-custody documentation.

The lid of each cooler will be sealed with two custody seals at opposite corners of the cooler, and covered by clean transparent shipping tape. The cooler will be sealed with clean shipping tape.



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## 16.0 SAMPLE CUSTODY DOCUMENTATION/FIELD LOGBOOK

Chain-of-custody procedures will ensure proper documentation of possession and handling of samples from the time they are collected until analysis at the laboratory. Information provided to document chain-of-custody possession will include the APT Project number, signature of samplers, sample numbers, dates and times of collection, signatures of individuals involved in sample transfer, and the air bill or other shipping number.

Documentation and chain-of-custody procedures will include the following:

- Sample Identification.
- Sample Labels.
- Cooler Seals.
- Field Logbook.
- Chain-of-Custody Forms.

Chain-of-custody procedures to be followed by Pace after delivery of the samples are presented in the Laboratory QAP (Appendix D of the multi-site QAPP for this project).

### 16.1 SAMPLE IDENTIFICATION

Samples will be assigned a unique sample ID code. Sample nomenclature for the soil samples will consist of the soil boring identification number followed a semicolon and the depth BGS at which the soil sample is collected. For example, a soil sample collected from a depth of 25 feet BGS in soil boring SB-1 would be identified as *SB-1; 25'*.

Sample nomenclature for the groundwater samples will consist of the monitoring well identification number followed by a semicolon and the six-digit representation of the date on which the groundwater sample is collected. For example, a groundwater sample collected from monitoring well MW-1 on March 15, 2004 would be identified as *MW-1; 031504*.

Sample nomenclature for the surface water sample will consist of the surface water identification number followed by a semicolon and the six-digit representation of the date on which the groundwater sample is collected. For example, a surface water sample collected from surface water the first surface water sampling location on February 15, 2004 would be identified as *SW-1; 021504*.

Sample nomenclature for the sediment sample will consist of the sediment identification number followed by a semicolon and the six-digit representation of the date on which the sediment sample is collected. For example, a sediment sample collected from the third sediment sampling location on November 9, 2003 would be identified *SD-3; 110903*.



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Duplicate soil samples will be identified by the prefix "DUP" followed by a dash, a sequential integer to designate the duplicate number, semicolon, and the depth BGS. For example, the first duplicate soil sample collected during the project from a depth of 25 feet BGS in soil boring SB-1 would be identified as *DUP-1; 25'*. A second duplicate sample from another boring would be identified as *DUP-2; depth*. The soil boring that the duplicate was obtained from will be identified only in the field notebook in order to obtain a "blind" duplicate.

Duplicate groundwater samples will be identified by the prefix "DUP" followed by a dash, a sequential integer designating the duplicate sample number for that round of sampling, a semicolon, and the six-digit representation of the date. For example, a duplicate groundwater sample collected from monitoring well MW-1 on August 15, 2003 would be identified as *DUP-1; 031503*. If a second duplicate sample were collected on August 15, 2003 (*i.e.*, during the same sampling event) from monitoring well MW-3, it would be identified as *DUP-2; 031503*. The monitoring wells from which the duplicate samples were collected would be identified only in the field notebook.

Duplicate surface water samples will be identified by the prefix SWDUP followed by a dash, a sequential integer designating the duplicate number for that round of sampling, a semicolon, and the six-digit representation of the date. For example, a duplicate surface water sample collected on July 20, 2003 would be identified as *SWDUP-1; 072003*. If a second duplicate sample were collected on July 20, 2003 (*i.e.*, during the same sampling event), it would be identified as *SWDUP-2; 072003*. The surface sample locations from which the duplicate samples were collected would be identified only in the field notebook.

Duplicate sediment samples will be identified by the prefix SDDUP followed by a dash, a sequential integer designating the duplicate number for that round of sampling, a semicolon, and the six-digit representation of the date. For example, a duplicate sediment sample collected on September 1, 2003 would be identified as *SDDUP-1; 090103*. If a second duplicate sample were collected on September 1, 2003 (*i.e.*, during the same sampling event), it would be identified as *SDDUP-2; 090103*.

Trip blanks will be identified by the prefix "TB" followed by the six-digit representation of the date. For example, a trip blank collected on March 15, 2003 would be identified as *TB; 031503*.

Methanol blanks will be identified by the prefix "MB" followed by the six-digit representation of the date. For example, a methanol blank collected on April 25, 2003 would be identified as *MB; 042503*.

Equipment rinsate blanks will be identified by the prefix "ER" followed by the six-digit representation of the date. For example, an equipment rinsate blank collected on March 15, 2003 would be identified as *ER; 031503*.

MS/MSDs for soil will be identified by the prefix "MS" and "MSD", respectively, followed by a dash, the soil boring name, a semicolon, and the depth BGS at which the sample was collected.



For example, a MS/MSD sample collected from a depth of 25 feet BGS in soil boring SB-1 would be identified as *MS/MSD-SB1; 25'*.

MS/MSDs for groundwater will be identified by the prefix "MS" and "MSD", respectively, followed by a dash, the monitoring well sampled, a semicolon, and the six-digit representation of the date the sample was collected. For example, a MS/MSD collected from monitoring well MW-5 on October 30, 2003 would be identified as *MS/MSD MW-3; 103003*.

MS/MSDs for surface water will be identified by the prefix "MS" and "MSD", respectively, followed by a dash, the surface water location, a semicolon, and the six-digit representation of the date the sample was collected. For example, a MS/MSD collected from the first surface water sample location on August 1, 2003 would be identified as *MS/MSD SW-1; 080103*.

MS/MSDs for sediment will be identified by the prefix "MS" and "MSD", respectively, followed by a dash, the sediment sample location, a semicolon, and the six-digit representation of the date the sample was collected. For example, a MS/MSD collected from the fifth sediment sample location on May 14, 2003 would be identified as *MS/MSD SD-5; 051403*.

The corresponding sample identification number recorded in the Field Logbook will be used on the sample label and the chain-of-custody form for each sample for reference purposes. The correlation of sample designation to the sample number will be recorded in the Field Logbook.

## 16.2 SAMPLE LABELS

To identify the contents of each sample container, a sample label completed with a waterproof marker will be firmly attached to each sample container. Each sample label will be completed with the following information:

- Date and time of sampling;
- Sample ID number;
- Place of sampling (Karwick Road Landfill site);
- Type of preservative;
- Parameters to be analyzed; and
- Name(s), initials of the sampler(s).

Sample labels and chain-of-custody entries for duplicate samples will not include any information regarding the boring or monitoring well number or the time of collection so that the laboratory will not know which well these samples were taken from. The locations of the duplicates will be noted in the Field Logbook.

## 16.3 COOLER SEALS

In the event that the samples will change hands en route to the laboratory, such as when shipped via overnight courier, chain-of-custody seals will be affixed at opposite corners the lid of the



cooler to ensure that the container has not been opened during shipment. For the purposes of this project, it is important to document the persons who have access to the samples and to confirm that the samples have not been exposed to undocumented conditions or persons which may impact the integrity of the samples, thus impacting the results of the analytical tests. Two seals will be affixed to each shipping container and fastened so that the container cannot be opened without breaking at least one of the seals. The custody seals will be completed with the date of sealing and signature of the sampler. The cooler will also be further secured for shipment using clear shipping tape. The condition of the custody seal, as well as the name of the sampler and the sampling date, will be recorded in the Field Logbook. Upon arrival at the laboratory, the condition of the custody seals will be examined by laboratory personnel for signs of tampering during transit.

#### 16.4 FIELD LOGBOOK

A bound Field Logbook, designated "Karwick Road Landfill – 312-01" will be used to record notes and observations during the closure activities. All entries into the Field Logbook will be made in permanent ink. Cross-outs, corrections, and additions to the entries will be initialed and dated. Ambient weather information will be recorded in the Field Logbook. This will include approximate temperature, wind velocity and direction, cloud cover, and precipitation information. The ground surface near the wellhead will be visually inspected for standing water or other soil conditions. These observations will also be recorded in the Field Logbook.

For sampling event: the site name and location, date, starting and ending times, weather, names of all people involved in sampling activities, level of personal protection used, documentation of adherence to protocol, any changes made to planned protocol, names of visitors to the site during sampling and reason for their visit, unusual observations, and signature of the person recording the information.

For each individual sample: a detailed description of location, any measurements made, the unique sample number assigned, the time the sample was taken, physical description of sample, depth from which sample was collected, whether grab or composite (if composite, how composited), equipment used to collect the sample, volume and number of sample containers, how sample is preserved, and initials of sampler. Each field duplicate must be given its own unique sample number; the description should include the unique sample number of its duplicate.

The field logbook will include comments regarding the following:

- Purpose of sampling event and identification of each sample location;
- General field observations;
- Name(s) of field personnel on site;
- Name(s) of site visitors;
- Climactic conditions - approximate temperature, wind speed and direction, and precipitation/cloud cover;



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- Well maintenance and sampling information including:
  - Well stick-up; and
  - Problems noting well condition and maintenance.
- Sample procedure/equipment;
- Date and time of calibration of field-testing equipment;
- Equipment calibration (recorded each time the instruments are calibrated) and file data including:
  - Standards used;
  - Field meter identification;
  - Calibration results; and
  - Name of person who performed calibrations.
- Deviations, if any, from the SAP or QAPP;
- Depth to water;
- Total well or boring depth;
- Purge volume (groundwater sampling);
- Sample locations and depths;
- Sample collection procedures;
- Sample identification numbers;
- General sample appearance (color, odor noted, etc.), including presence/absence of visual impact;
- Types and source of sample containers;
- Preservatives used;
- Parameters for analysis;
- Date and time of sample collection; and
- Sample transport method and transporter.

All sample identification numbers will be recorded in the Field Logbook, along with a sketch showing sample locations associated with each sample number.

In addition to general comments and observation included in the Field Logbook, a Soil Boring Log form will also be completed for each soil sampling location, documenting the following:

- A general Field Description including soil boring I.D.; date; well logger's name, title and affiliation; narratives of geologic and drilling observations (e.g., blow counts, soil color, consistence, etc.); and total depth;
- United States Department of Agriculture (USDA) texture;
- Unified Soil Classification System (USCS) Classification;



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- Lithologic description, including roundness (where applicable), sorting, grain size using the modified "Wentworth" grade size scale, and mineralogy (where appropriate);
- Color, using the Munsell Soil Color Charts (Munsell Color, 1975);
- Soil structures (soil horizons);
- Sedimentary features, such as bedding, stratification, deterioration, bioturbation, etc.
- Consistency;
- Moisture;
- Zones of secondary priority, including fractures, root chemicals, animal burrows, dissolution pores, etc., and
- Other miscellaneous features, such as apparent contamination (odors, staining) and other pertinent information not mentioned above.

## 16.5 CHAIN-OF-CUSTODY FORM

The field portion of the custody documentation should include: (1) project name; (2) signatures of samplers; (3) sample number, date and time of collection, and whether the sample is grab or composite; (4) signatures of individuals handling samples; and (5) air bill or other shipping number.

A chain-of-custody form will be filled out and accompany the samples to the analytical laboratory. The form will also serve as a sample analysis request form, communicating to the laboratory the exact analysis (including method number) to be performed on each sample submitted. The chain-of-custody form will include the following information:

- Sample identification number;
- Signature of sample collector and other individuals in chain of possession;
- Date(s) and time(s) of collection;
- Date(s) and time(s) of relinquishment by individuals in chain of possession;
- Identification of analytical laboratory;
- Sample matrix;
- Sample container descriptions, number of sample containers per analysis, and types of analysis to be performed including analytical method numbers;
- Laboratory identification number (completed by laboratory);
- Integrity of cooler seals (to be noted by laboratory, if applicable); and
- Special instructions and remarks.



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## **16.6 LABORATORY LOGBOOK**

The laboratory will have an acceptable quality assurance and quality control program. Among the necessary procedures will be the maintenance of laboratory logbooks. Commercial laboratories selected will certify the use of and make available for inspection laboratory logbooks. The type of information to be recorded in the logbooks is specified in the laboratory QAP (Appendix D of the multi-site QAPP).



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## 17.0 RE-SAMPLING

If during sampling any samples are broken or lost prior to analysis, the specific sample and media will be re-sampled by the same or an alternate method identified in this SAP and submitted for the parameters corresponding to the lost or broken sample containers. Re-sampling will be conducted within two weeks of the original sampling date.



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## 18.0 SUBMITTAL OF ANALYTICAL RESULTS

The soil, groundwater, surface water, and sediment analytical results will be submitted to the USEPA and the IDEM for review as part of the *VRP Remediation Work Plan*. The analytical results will be submitted to the MCEDC in interim status reports following receipt from the laboratory. These reports will include the data validation results, as described in the multi-site QAPP.

The analytical results package will include sampling dates, analysis dates, analytical methods used, practical quantitation limits, quality control results, and signed copies of the chain-of-custody forms. The QA/QC results will include blank results, matrix spike/matrix spike duplicate results, surrogate recoveries (as appropriate for the analysis), tuning results (CC-MS), and initial calibration results.

Copies of the pertinent Field Logbook entries will be submitted in the reports to IDEM and USEPA if requested, and will also be copied to MCEDC management for filing.



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## TABLES

- 1 Sample Container, Preservation, and Holding Time Requirements



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TABLE 1  
SAMPLE BOTTLES, METHODS, PRESERVATIVES, AND HOLD TIMES  
Sampling and Analysis Plan  
Karwick Road Landfill - Michigan City, Indiana

Sample Name <sup>1</sup>	Sample Matrix	Number of Samples	Sample Type	Containers & Preservative	Analytical Parameters <sup>2</sup>	Hold Times	Analytical Methods
SB-#:[depth]	Soil	40 surface; 40 subsurface	Investigative	1. 40-mL Vial with Methanol 2. 40-mL Vial Non-preserved 1. 4 oz PTFE-lined container	VOCs	14 days (Methanol) 7-days (Non-Preserved & frozen upon receipt by lab) 3 days (Non-Preserved, 4" C)	IN-5035M Preservation SW-846 Method 8260
				1. 4 oz Jar Non-preserved (30 g) (4" C)	SVOCs	14 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 4 oz Jar Non-preserved (10 g) (4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
MW-#:[date]	Groundwater	16 VOCs; 16 SVOCs; 24 PPL Metals	Investigative	3. 40-mL Vials (HCl < pH 2, 4" C)	VOCs	14 days	SW-846 Method 8260
				2. 1-L Amber (Non-Preserved, 4" C)	SVOCs	7 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 500-mL Bottle (HNO <sub>3</sub> , 4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
SW-#:[date]	Surface Water	34	Investigative	3. 40-mL Vials (HCl < pH 2, 4" C)	VOCs	14 days	SW-846 Method 8260
				2. 1-L Amber (Non-Preserved, 4" C)	SVOCs	7 days Extract, 40 days Analysis	SW-846 Method 8270
SD-#:[date]	Sediment	10	Investigative	1. 4 oz Jar Non-preserved (30 g) (4" C)	SVOCs	14 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 4 oz Jar Non-preserved (10 g) (4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
				1. 4 oz Jar Non-preserved (30 g) (4" C)	PCBs	14 days Extract, 40 days Analysis	SW-846 Method 8082
MB-#:[date]	Methanol	4	Methanol Blank	3. 40-mL Vials with Methanol	VOCs	14 days	IN-5035M Preservation SW-846 Method 8260
TB-#:[date]	Aqueous	9	Trip Blank	3. 40-mL Vials (HCl < pH 2, 4" C)	VOCs	14 days	SW-846 Method 8260
DUP-#:[depth]	Soil	4 surface; 4 subsurface	Duplicate	1. 40-mL Vial with Methanol 2. 40-mL Vial Non-preserved 1. 4 oz PTFE-lined container	VOCs	14 days (Methanol) 7-days (Non-Preserved & frozen upon receipt by lab) 3 days (Non-Preserved, 4" C)	IN-5035M Preservation SW-846 Method 8260
				1. 4 oz Jar Non-preserved (30 g) (4" C)	SVOCs	14 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 4 oz Jar Non-preserved (10 g) (4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
DUP-#:[date]	Groundwater	4	Duplicate	3. 40-mL Vials (HCl < pH 2, 4" C)	VOCs	14 days	SW-846 Method 8260
				2. 1-L Amber (Non-Preserved, 4" C)	SVOCs	7 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 500-mL Bottle (HNO <sub>3</sub> , 4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
SWDUP-#:[date]	Surface Water	5	Duplicate	3. 40-mL Vials (HCl < pH 2, 4" C)	VOCs	14 days	SW-846 Method 8260
				2. 1-L Amber (Non-Preserved, 4" C)	SVOCs	7 days Extract, 40 days Analysis	SW-846 Method 8270
SDDUP-#:[date]	Sediment	1	Duplicate	1. 4 oz Jar Non-preserved (30 g) (4" C)	SVOCs	14 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 4 oz Jar Non-preserved (10 g) (4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
				1. 4 oz Jar Non-preserved (30 g) (4" C)	PCBs	14 days Extract, 40 days Analysis	SW-846 Method 8082
MS/MSD SB-#:[depth]	Soil	2 MS; 2 MSD	Matrix Spike/Matrix Spike Duplicate	1. 40-mL Vial with Methanol 2. 40-mL Vial Non-preserved 1. 4 oz PTFE-lined container	VOCs	14 days (Methanol) 7-days (Non-Preserved & frozen upon receipt by lab) 3 days (Non-Preserved, 4" C)	IN-5035M Preservation SW-846 Method 8260
				1. 4 oz Jar Non-preserved (30 g) (4" C)	SVOCs	14 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 4 oz Jar Non-preserved (10 g) (4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
MS/MSD MW-#:[date]	Groundwater	4 MS; 4 MSD	Matrix Spike/Matrix Spike Duplicate	3. 40-mL Vials (HCl < pH 2, 4" C)	VOCs	14 days	SW-846 Method 8260
				2. 1-L Amber (Non-Preserved, 4" C)	SVOCs	7 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 500-mL Bottle (HNO <sub>3</sub> , 4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
MS/MSD SW-#:[date]	Surface water	5 MS; 5 MSD	Matrix Spike/Matrix Spike Duplicate	2. 1-L Amber (Non-Preserved, 4" C)	VOCs	14 days	SW-846 Method 8260
				1. 500-mL Bottle (HNO <sub>3</sub> , 4" C)	SVOCs	7 days Extract, 40 days Analysis	SW-846 Method 8270
MS/MSD SD-#:[depth]	Sediment	1 MS; 1 MSD	Matrix Spike/Matrix Spike Duplicate	1. 4 oz Jar Non-preserved (30 g) (4" C)	SVOCs	14 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 4 oz Jar Non-preserved (10 g) (4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471
				1. 4 oz Jar Non-preserved (30 g) (4" C)	PCBs	14 days Extract, 40 days Analysis	SW-846 Method 8082
ER-#:[date]	Aqueous	17	Equipment Rinsate Sample	3. 40-mL Vials (HCl < pH 2, 4" C)	VOCs	14 days	SW-846 Method 8260
				2. 1-L Amber (Non-Preserved, 4" C)	SVOCs	7 days Extract, 40 days Analysis	SW-846 Method 8270
				1. 500-mL Bottle (HNO <sub>3</sub> , 4" C)	PPL Metals	6 months (24 hr Cr6, 28 days Hg)	SW-846 Methods 6010/7471

Notes:

1. The soil samples to be collected by APT from soil borings advanced by Top Flight Environmental Drilling Services.

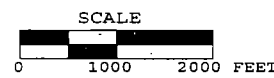
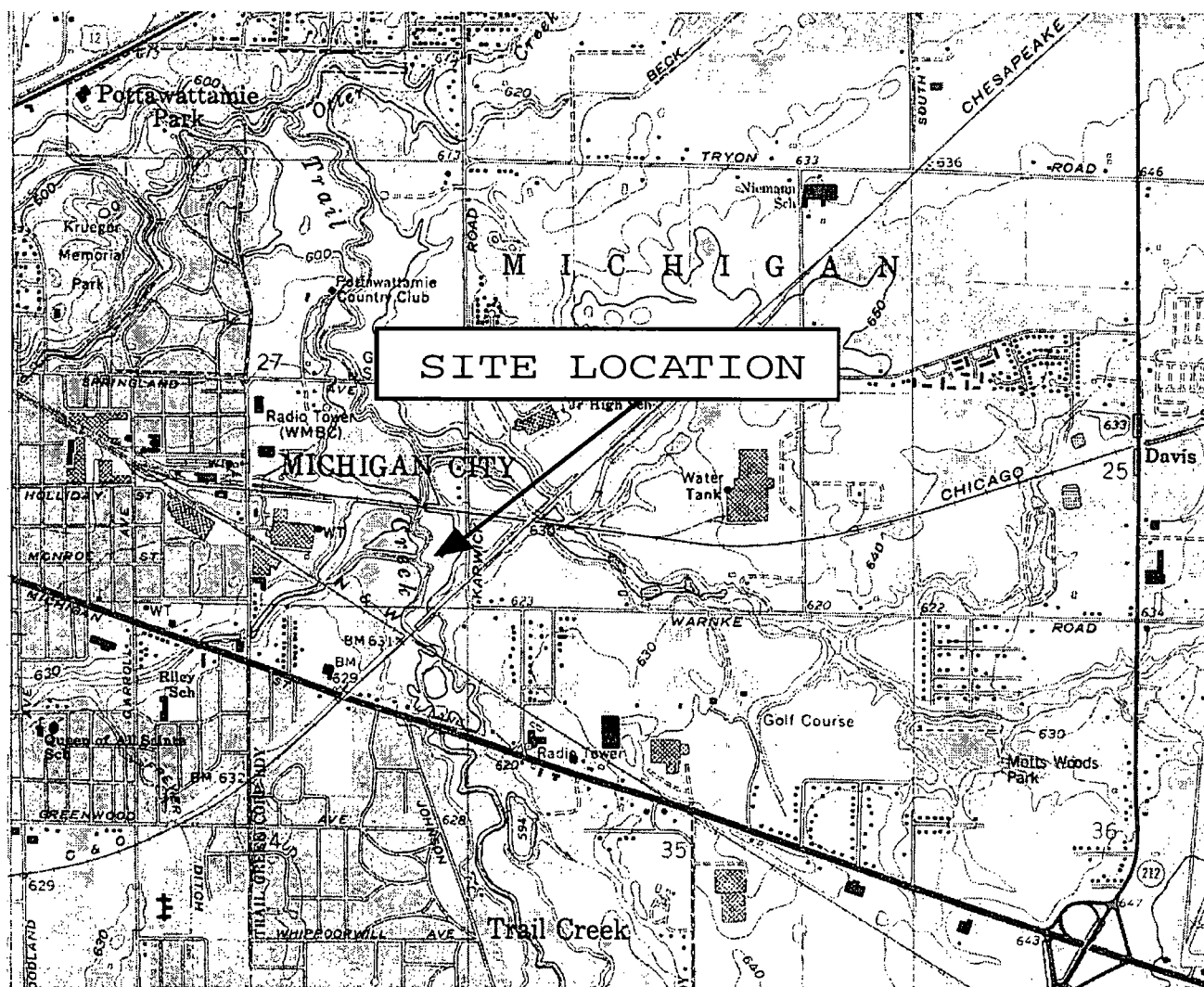
2. Samples to be analyzed by Pace Analytical of Indianapolis, Indiana for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), priority pollutant list (PPL) metals, and polychlorinated biphenyls (PCBs) using the stated analytical method.

## FIGURES

- 1 Site Location Map
- 2 Site Map
- 3 Soil Analytical Results – July 2001
- 4 Groundwater Screening Analytical Results – July 2001
- 5 Groundwater Analytical Results – December 3, 2001
- 6 Proposed Soil, Surface water, and Sediment Sample Locations



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USGS QUAD MICHIGAN CITY EAST, IN 7.5 MINUTE 1969 (REV. 1980)

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TASK: 1

DWG: 312.1.F1.SL

DATE: 9-12-02

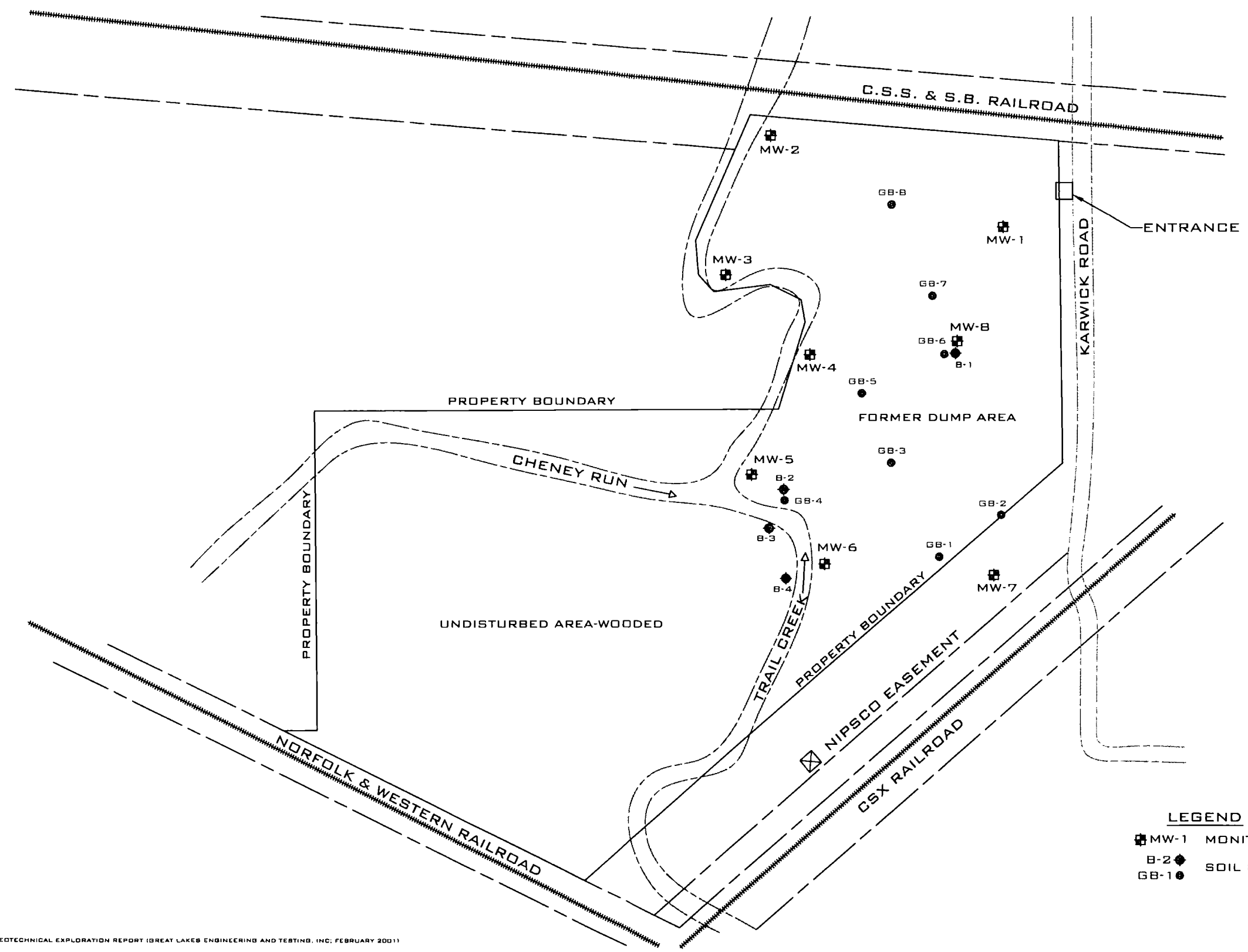
DWG BY: AB

M. C. PARKS & RECREATION  
MICHIGAN CITY, IN

PREPARED FOR  
M. C. PARKS & RECREATION  
MICHIGAN CITY, IN

**FIGURE 1**

**SITE LOCATION MAP**



REFERENCE: SOURCE DRAWING FROM GEOTECHNICAL EXPLORATION REPORT (GREAT LAKES ENGINEERING AND TESTING, INC.; FEBRUARY 2001)

**LEGEND**

■ MW-1 MONITORING WELL LOCATION

◆ B-2

● GB-1 SOIL BORING LOCATION



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**TASK 8**

DWG: 312.1.F2.MWSB

DATE: 3-6-03

DWG BY: AB

KARWICK ROAD SITE  
MICHIGAN CITY, IN

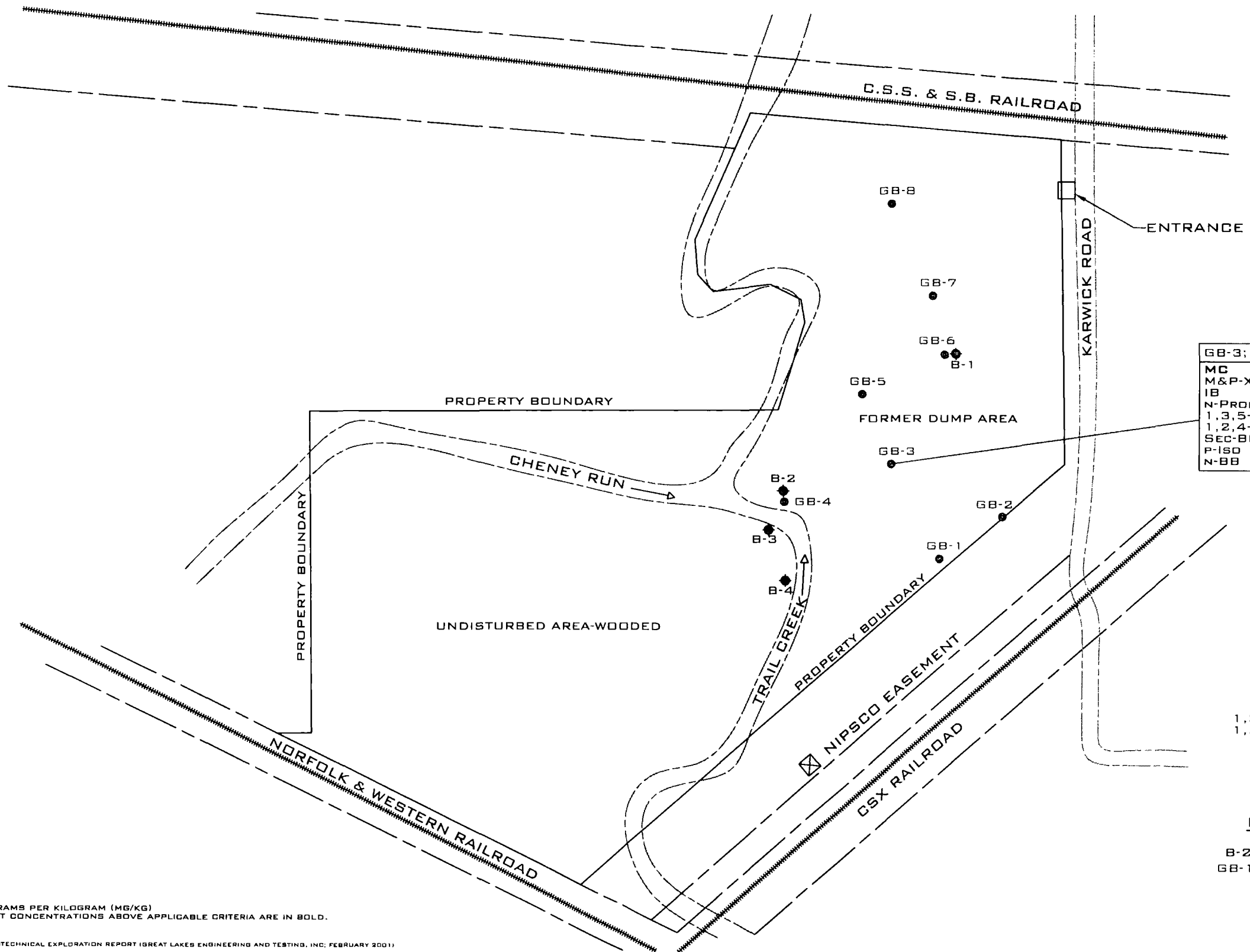
**PREPARED FOR**

MICHIGAN CITY PARKS & RECREATION  
MICHIGAN CITY, INDIANA

**FIGURE 2**

**SITE MAP**





GB-3; 8'	
MC	39
M&P-X	190
IB	27
N-PROP	43
1,3,5-TMB	66
1,2,4-TMB	730
SEC-BB	30
P-ISO	31
N-BB	43

KEY	
MC	METHYLENE CHLORIDE
M&P-X	M&P-XYLENES
IB	ISOPROPYLBENZENE
N-PROP	N-PROPYLBENZENE
1,3,5-TMB	1,3,5-TRIMETHYLBENZENE
1,2,4-TMB	1,2,4-TRIMETHYLBENZENE
SEC-BB	SEC-BUTYLBENZENE
P-ISO	P-ISOPROPYLTOLUENE
N-BB	N-BUTYLBENZENE

**LEGEND**

B-2 ● SOIL BORING LOCATION  
GB-1 ●



NOTE: 1. CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (MG/KG)  
2. CONSTITUENTS DETECTED AT CONCENTRATIONS ABOVE APPLICABLE CRITERIA ARE IN BOLD.

REFERENCE: SOURCE DRAWING FROM GEOTECHNICAL EXPLORATION REPORT (GREAT LAKES ENGINEERING AND TESTING, INC; FEBRUARY 2001)



**KEY**

**VOCs**

CM CHLOROMETHANE  
CIS-1,2-DCE CIS-1,2-DICHLOROETHANE  
CB CHLOROBENZENE  
X XYLENE (TOTAL)  
1,2,4-TMB 1,2,4-TRIMETHYLBENZENE  
P-ISO P-ISOPROPYLTOLUENE  
1,4-DCB 1,4-DICHLOROBENZENE  
NAP NAPHTHALENE  
4-METH 4-METHYL-2-PENTANONE (MIBK)

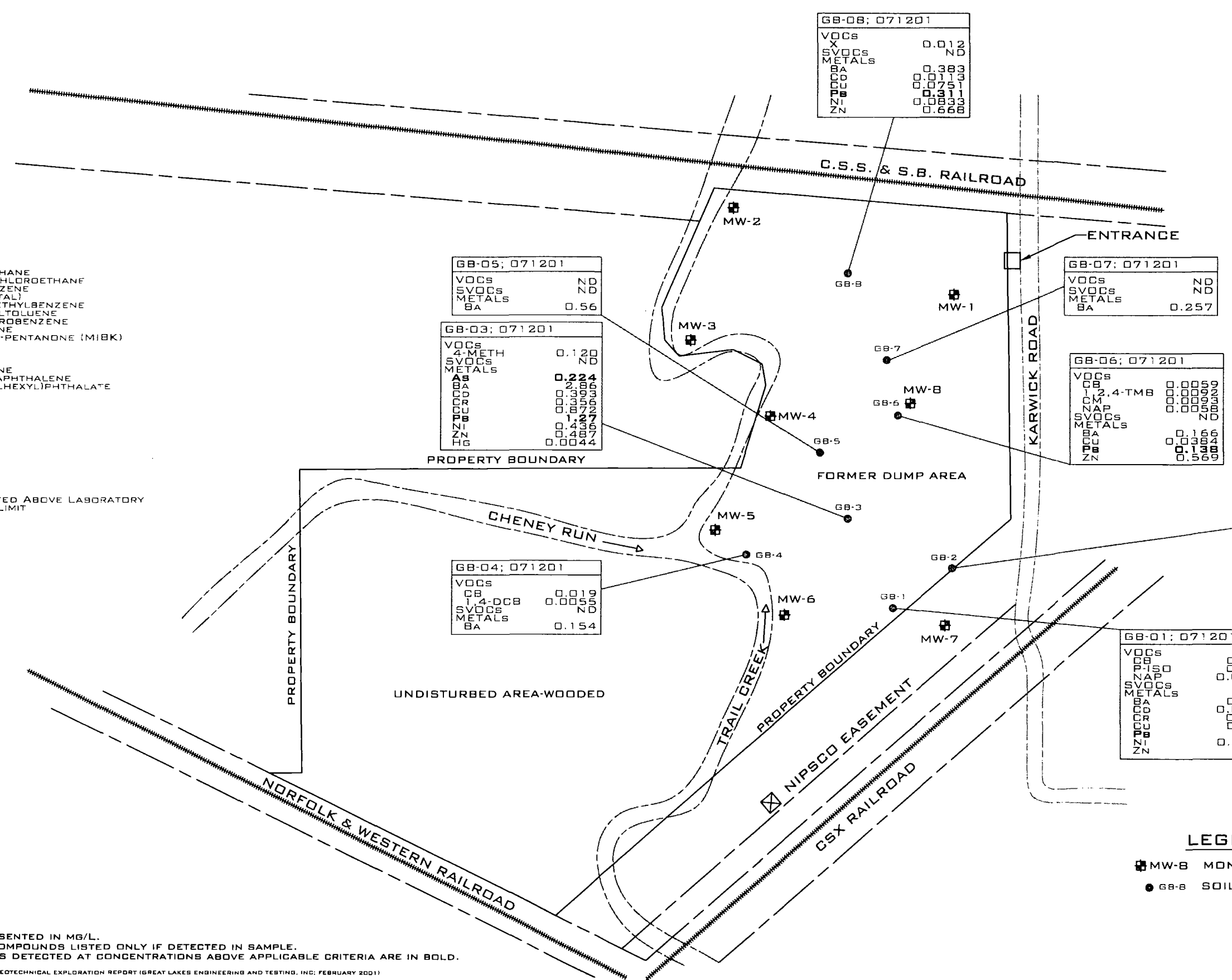
**SVOCs**

NAP NAPHTHALENE  
2-METH 2-METHYLNAPHTHALENE  
BIS BIS(2-ETHYLHEXYL)PHTHALATE

**METALS**

AS ARSENIC  
BA BARIUM  
CD CADMIUM  
CR CHROMIUM  
CU COPPER  
PB LEAD  
NI NICKEL  
ZN ZINC  
HG MERCURY

ND NOT DETECTED ABOVE LABORATORY  
DETECTION LIMIT



**GB-02; 071201**

VOCs	
CIS-1,2-DCE	0.010
X	0.012
1,2,4-TMB	0.0085
NAP	0.0085
SVOCs	
NAP	0.130
2-METH	0.130
BIS	0.130
METALS	
AS	0.509
BA	3.999
CD	0.0794
CR	1.6099
CU	1.6099
PB	1.7099
NI	1.7099
ZN	1.7099
HG	0.0242

**GB-01; 071201**

VOCs	
CB	0.013
P-ISO	0.005
NAP	0.008
SVOCs	ND
METALS	
BA	0.516
CD	0.0155
CR	0.114
CU	0.114
PB	2.09
NI	0.0966
ZN	1.54

**GB-07; 071201**

VOCs	ND
SVOCs	ND
METALS	
BA	0.257

**GB-06; 071201**

VOCs	
CB	0.0005
1,2,4-TMB	0.0005
CM	0.0005
NAP	0.0005
SVOCs	ND
METALS	
BA	0.155
CD	0.155
CR	0.155
CU	0.155
PB	0.155
NI	0.155
ZN	0.155

**GB-05; 071201**

VOCs	ND
SVOCs	ND
METALS	
BA	0.56

**GB-03; 071201**

VOCs	
4-METH	0.120
SVOCs	ND
METALS	
AS	0.224
BA	2.0005
CD	0.0005
CR	0.0005
CU	0.0005
PB	1.27
NI	0.436
ZN	0.436
HG	0.0044

**GB-04; 071201**

VOCs	
CB	0.019
1,4-DCB	0.0055
SVOCs	ND
METALS	
BA	0.154

**GB-08; 071201**

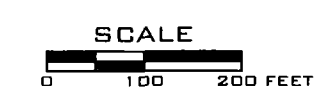
VOCs	
X	0.012
SVOCs	ND
METALS	
BA	0.383
CD	0.0113
CR	0.0113
CU	0.0113
PB	0.311
NI	0.311
ZN	0.311

**NOTES:** 1. RESULTS PRESENTED IN MG/L.  
2. INDIVIDUAL COMPOUNDS LISTED ONLY IF DETECTED IN SAMPLE.  
3. CONSTITUENTS DETECTED AT CONCENTRATIONS ABOVE APPLICABLE CRITERIA ARE IN BOLD.

REFERENCE: SOURCE DRAWING FROM GEOTECHNICAL EXPLORATION REPORT (GREAT LAKES ENGINEERING AND TESTING, INC.; FEBRUARY 2001)

**LEGEND**

■ MW-8 MONITORING WELL LOCATIONS  
● GB-8 SOIL BORING LOCATIONS





MW-2; 120301	
VOCs	
CE	0.0082
B	0.011
CB	0.066
IB	0.0052
N-PROP	0.0058
1,2,4-TMB	0.028
SVOCs	
Bis	0.018
METALS	
BA	0.242
CU	0.0431
Pb	<b>0.171</b>
ZN	0.833

- KEY**
- VOCs**
- CE CHLOROETHANE
  - 1,1-DCA 1,1-DICHLOROETHANE
  - B BENZENE
  - T TOLUENE
  - CB CHLOROBENZENE
  - X XYLENE (TOTAL)
  - IB ISOPROPYLBENZENE (CUMENE)
  - N-PROP N-PROPYLBENZENE
  - 1,2,4-TMB 1,2,4-TRIMETHYLBENZENE
  - 1,3-DCB 1,3-DICHLOROBENZENE
  - 1,4-DCB 1,4-DICHLOROBENZENE
  - NAP NAPHTHALENE
- SVOCs**
- NAP NAPHTHALENE
  - Bis BIS(2-ETHYLHEXYL)PHTHALATE
- METALS**
- BA BARIUM
  - CD CADMIUM
  - CR CHROMIUM
  - CU COPPER
  - Pb LEAD
  - NI NICKEL
  - ZN ZINC
  - HG MERCURY
- ND NOT DETECTED ABOVE LABORATORY DETECTION LIMIT

MW-4; 120301	
VOCs	
CE	<b>1.60</b>
1,1-DCA	0.13
B	0.019
T	0.090
CB	0.022
X	0.0063
1,2,4-TMB	0.042
NAP	0.073
SVOCs	
NAP	0.043
Bis	0.044
METALS	
BA	0.428
CR	0.0716
CU	0.109
Pb	<b>0.222</b>
NI	0.0671
ZN	0.845

MW-3; 120301	
VOCs	
CE	0.011
B	0.0053
CB	0.020
1,2,4-TMB	0.0095
SVOCs	
NAP	ND
METALS	
BA	0.290
CU	0.0213
Pb	0.0189
ZN	0.0829

MW-1; 120301	
VOCs	
CE	ND
SVOCs	
NAP	ND
METALS	
Pb	0.0139
ZN	0.0524

MW-8; 120301	
VOCs	
CB	0.150
1,2,4-TMB	0.035
1,3-DCB	0.0093
1,4-DCB	0.011
NAP	0.0078
SVOCs	
Bis	0.011
METALS	
BA	0.596
CD	0.011
CR	0.155
CU	0.151
Pb	<b>0.279</b>
NI	0.155
ZN	1.04

MW-5; 120301	
VOCs	
CB	0.0067
SVOCs	
NAP	ND
METALS	
BA	0.339
ZN	0.0508

MW-6; 120301	
VOCs	
CB	0.021
SVOCs	
Bis	0.015
METALS	
BA	0.241
CR	0.0637
CU	0.0375
Pb	<b>0.0515</b>
ZN	0.211

MW-7; 120301	
VOCs	
NAP	0.0055
SVOCs	
Bis	0.0025
METALS	
BA	0.710
CR	0.0889
CU	0.167
Pb	<b>0.866</b>
NI	0.060
ZN	1.55
Hg	0.00218

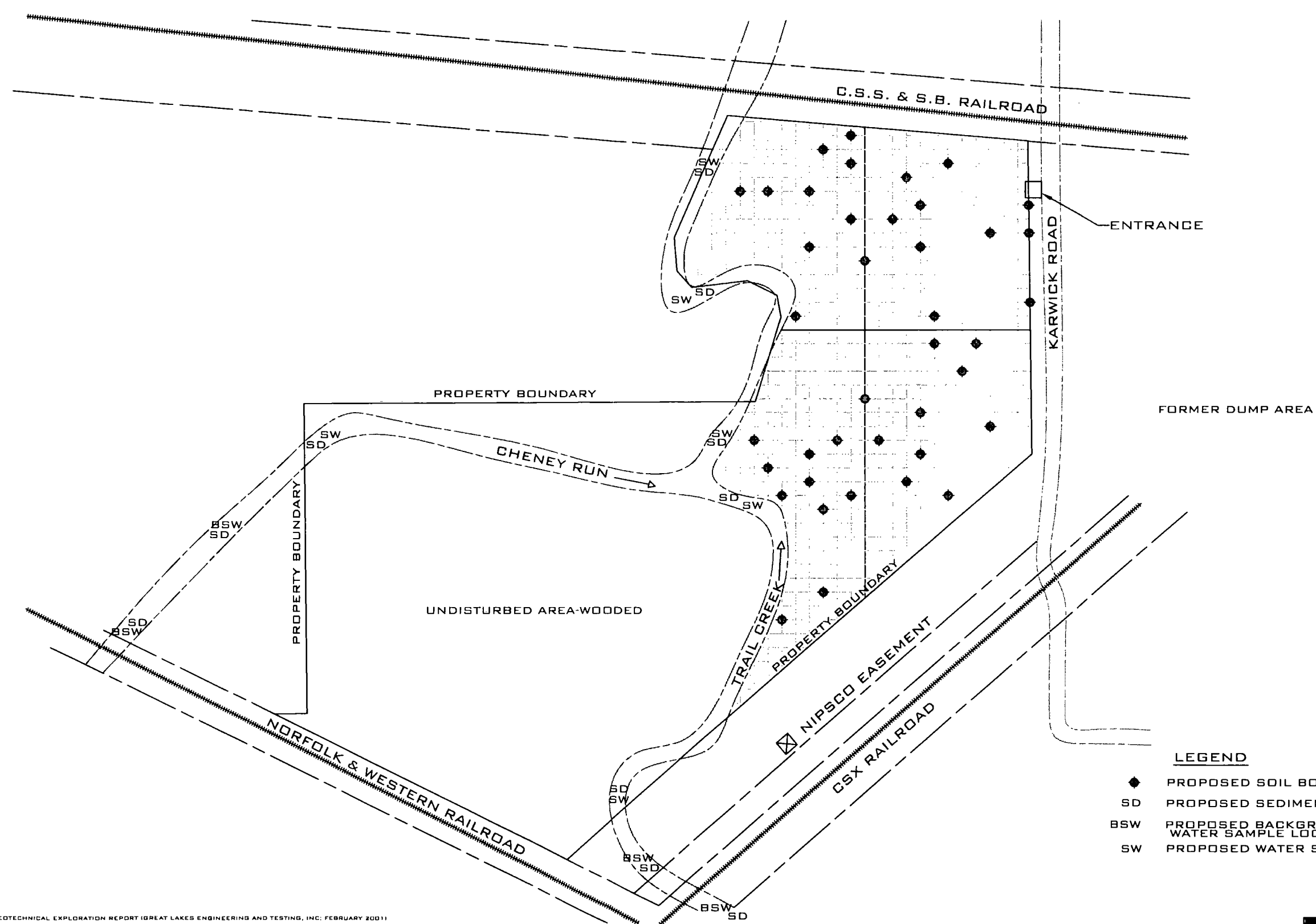
**LEGEND**

■ MW-8 MONITORING WELL LOCATIONS

NOTES: 1. RESULTS PRESENTED IN MG/L.  
2. INDIVIDUAL COMPOUNDS LISTED ONLY IF DETECTED IN SAMPLE.  
3. CONSTITUENTS DETECTED AT CONCENTRATIONS ABOVE APPLICABLE CRITERIA ARE IN BOLD.

REFERENCE: SOURCE DRAWING FROM GEOTECHNICAL EXPLORATION REPORT (GREAT LAKES ENGINEERING AND TESTING, INC.; FEBRUARY 2001)





- LEGEND**
- ◆ PROPOSED SOIL BORING LOCATION
  - SD PROPOSED SEDIMENT SAMPLE LOCATION
  - BSW PROPOSED BACKGROUND SURFACE WATER SAMPLE LOCATION
  - SW PROPOSED WATER SAMPLE LOCATION



REFERENCE: SOURCE DRAWING FROM GEOTECHNICAL EXPLORATION REPORT (GREAT LAKES ENGINEERING AND TESTING, INC.; FEBRUARY 2001)

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		DWG: 312.B.F6.PSB		
		DATE: 3-18-03		
		DWG BY: AB	<b>PREPARED FOR</b> MICHIGAN CITY PARKS & RECREATION MICHIGAN CITY, INDIANA	